Quality of Fish in Retail Markets of Bombay

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Study carried out on the quality of fresh fish in retail markets of Bombay revealed that only 75% of the samples were of acceptable quality. Incidence of faecal streptococci was generally high, indicating poor sanitary and hygienic practices in handling of fresh fish. Total bacterial counts higher than Indian standard specified limits were observed in more than one third of the samples analysed. 7.5% of the samples were found to be contaminated either with Salmonella or *Clostridium perfringens*, thus posing a serious potential health hazard to the consumer. The quality of fish in different markets is also discussed. The urgent need for formulation and implementation of quality standards for fresh fish in domestic trade is highlighted.

India is a major fish producing country ranking seventh among the world nations. Out of the total fish production of about 2.5 million tonnes, less than 5% is exported to other countries, while the rest is sold in domestic markets for direct human consumption, and only a negligible quantity is utilised for reduction purposes. The fish and fishery products meant for export are subjected to rigorous quality tests at different stages of production and storage by individual entrepreneurs as well as by government agencies to ensure high quality finished product conforming to international standards. As the existing fish inspection and quality control measures are exclusively applied to export products, thus leaving out of their perview more than 95% of the total production for domestic consumption, immediate steps are needed to introduce and enforce quality control measures in this sector as well.

In India, much work has been done on different aspects of quality of processed fish and fishery products (Pillai *et al.* 1965); Iyer & Chaudhuri (1966) Iyer *et al.* (1966); Sreenivasan & Joseph (1966); Pillai & Rao (1969); Mathen *et al.* (1975); Valsan *et al.* (1982) and standards have been formulated for almost all the processed fish and fishery products. Quality standards for fresh fish cover only a few fish species available in markets. For the formulation and recommendation of quality standards for fresh fish in domestic trade a detailed background information and an indepth study of the present status is necessary which is very scanty. Khot *et al.* (1982) have reported on the bacterial flora of some common edible seafoods at retail level in Bombay.

The present study deals with the organoleptic, biochemical and bacteriological aspects of quality of fresh fish in retail outlets in Bombay. Bombay is a major fish landing centre in India with excellent harbour facilities. Apart from the biggest wholesale fish market in India where fish from other parts of the country arrive by different modes of transport, there are many retail fish markets situated at different localities of the city. Thus almost all the variety of marine, brackishwater and freshwater fishes are available throughout the year for catering to its cosmopolitan population. Hence, Bombay was selected as the most ideal location to carry out such a study.

Materials and Methods

Samples of fresh fish belonging to different species were drawn randomly at regular

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intervals from six important markets in Bombay (Fig. 1). Special emphasis was not given to a particular species while drawing samples. The marine, brackishwater and freshwater fishes included in the study Comprised of 23 major species and a few miscellaneous fishes. A pie diagram showing species wise distribution of the samples is given in Fig 2, each degree representing one sample. The samples were collected aseptically and transported to the laboratory under chilled condition and were analysed in detail for their physical, organoleptic, biochemical and bacteriological quality.

Organoleptic evaluation

The quality of fish was determined using organoleptic acceptability as the main criterion. Samples were examined physically for general appearance, odour, colour of the gills, eyes, slime and stages of rigor. Flavour, taste, and texture of the cooked meat was evaluated by cooking a part of the cleaned muscle in 3% brine for 10 min and serving to a three member trained panel. Based on all these aspects, scoring was given on a scale ranging between zero and ten.

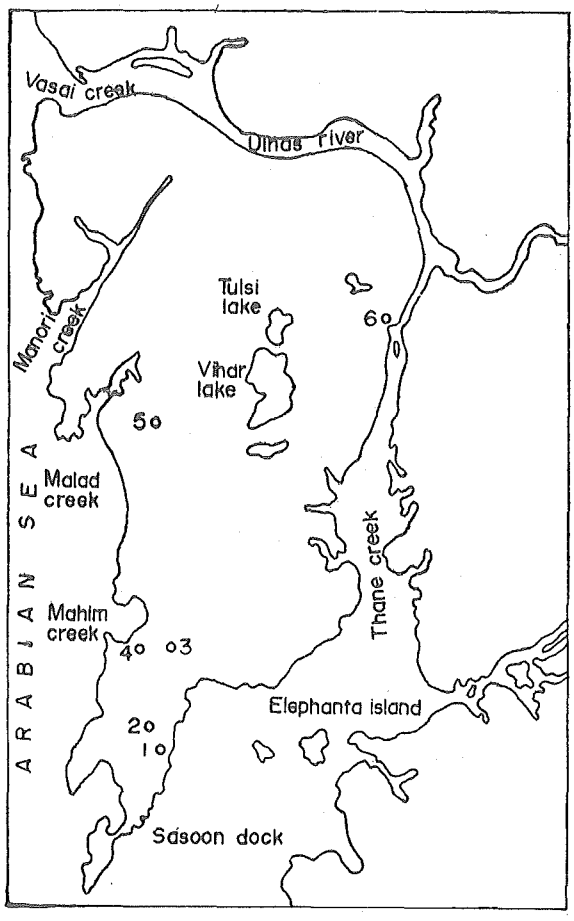

Fig. 1. Location of markets in Greater Bombay.

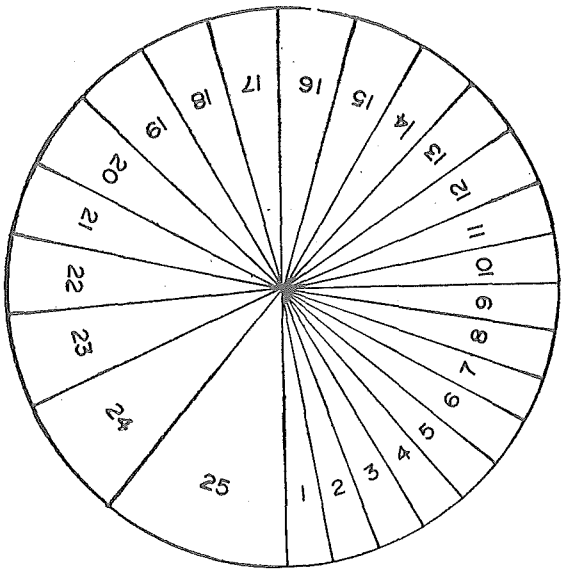

Fig. 2. Species-wise distribution of the samples.

1) Tilapia *(Tilapia mossambica)*
2) Tuna *(Euthynnus affinis)*
3) Shark *(Chiloscyllium indicum)*
4) Sardine *(Sardinella longiceps)*
5) Ray *(Himantura uarnak)*
6) Indian Salmon *(Eleutheronema tetradactylus)*
7) Japanese threadfin bream *(Nemipterus japonicus)*
8) Indian Pellona *(Pellona ditchela)*
9) Horse Mackerel *(Megalaspis cordyla)*
10) Red Snapper *(Lutianus ergentimacu latus)*
11) Black Pomfret *(Apolectus niger)*
12) Mackerel *(Rastrelliger kanagurta)*
13) Lactarius *(Lactarius lactarius)*
14) Other Freshwater fishes
15) Seer *(Scomberomorus guttatus)*
16) Ghol *(Pseudosciaena diacanthus)*
17) Cat fish *(Tachysurus sona)*
18) Bombay duck *(Harpodon nephereus)*
19) Sole *(Cynoglossus dubius)*
20) Dhoma *(Johnius dussumieri)*
21) Grey mullet *(Mugil cephalus)*
22) Hilsa *(Hilsa ilisha)*
23) Silver Pomfret *(Pampus argenteus)*
24) Silver bar *(Chirocentrus dorab)*
25) Other Marine and Brackishwater fishes

Total volatile nitrogen (TVN) value was chosen as the biochemical index of spoilage and was estimated by the microdiffusion method of Conway (1947). Total bacterial count, counts of *E. coli,* faecal streptococci and coagulase positive staphylococci were determined as per IS:2237 (1971). For the detection of salmonella, AOAC (1975) method was followed, and *Clostridium perfringens* was detected by the method described by Nambiar & Iyer (1973).

Results and Discussion

This study was conducted during 1981–82. The general quality of the fish samples based on different parameters is given in Table 1.

Table 1. *Quality characteristics of fresh fish from retail markets*

	Acceptable quality %	Poor quality %
Organoleptic score	77.3	22.7
TVN	78.4	21.6
Total bacterial count	74.4	25.6
E. coli	74.2	25.8
Faecal streptococci	60.6	39.4
Coagulase positive staph.	96.7	3.3
Salmonella	95.6	4.4
Clostridium perfringens	96.2	3.8

1) *Organoleptic quality*

Organoleptic evaluation is considered as the most authentic subjective test to assess the quality of fish from the consumer's point of view. A mean score of more than 7 out of 10 denoted the prime fresh condition of the fish with very high acceptability. Samples with scores between 7 and 5 can be considered as fair and less than 5 as of poor quality. Out of 360 samples analysed 18% were having a score more than 7, 59.3% between 7 and 5 and 22.7% less than 5. Based on this, 77.3% of the samples having a score of more than 5 could be considered as of acceptable quality and 22.7% as of poor quality.

2) *Biochemical quality*

The estimation of TVN is the most important objective test to assess the quality of fresh fish. TVN values increase with the bacterial spoilage of fish. The lowest TVN value obtained was 7.0 mg% and the highest was 98.0 mg%. Samples with TVN values below 12 mg% could be considered as good, between 12 and 20 mg% as fair and more than 20 mg% as of poor quality. Accordingly 21.1%, 57.3% and 21.6% of the samples fell under these three catagories. 78.4% of the samples having TVN values less than 20 mg% could be considered as of acceptable quality, which correlates well with the organoleptic assessment.

3) *Bacteriological quality*

a) Total bacterial count: Determination of total bacterial counts in fish is very important to assess the extent of spoilage as well as contamination. High bacterial counts could be either due to surface contamination or because of phenominal growth of bacteria during spoilage, which in any case is undesirable as they can cause further spoilage of fish rendering it unfit for human consumption. The total bacterial counts of the samples ranged from 1.73 10^3 to 2.09 x 10^7 g^{-1}. ISI specifications for certain fresh fish species limits the total bacterial counts to 5 lakhs g^{-1} (IS: 4780–4781 (1978). Only 61.7% of the samples could be considered as acceptable according to IS specifications. On the other hand, based on organoleptic and biochemical quality, 77.3% and 78.4% of the samples were found to be acceptable, respectively. High bacterial counts in more number of samples may be mainly due to surface contamination which has no direct correlation with the extent of spoilage. Considering the extent of surface contamination, count of less than 10 lakhs could be considered as acceptable and accordingly 74.4% of the samples were found to be of acceptable quality.

b) Faecal indicator organisms

E. coli and faecal streptococci are the most important faecal indicator organisms. Presence of these organisms indicate the direct

or indirect contamination of the material with faecal matter and possible presence of other potential enteric pathogens. Generally samples having *E. coli* counts more than 20 g^{-1} and faecal steptococci counts more than 100 g^{-1} are not acceptable. 74.2% of the samples had *E. coli* counts less than 20 g^{-1} and 60.6% had faecal streptococci counts less than 1000 g^{-1}. The highest counts obtained for *E. coli* and faecal streptococci were 4.0 x 10^3 g^{-1} and 4.03 x 10^4 g^{-1}, respectively. The presence of *E. coli* and faecal streptococci in high numbers in the samples is a reflection of poor hygienic and sanitary conditions prevailing at different stages of handling and marketing of fresh fish.

d) Salmonella

Salmonella is a highly pathogenic organism and food materials shall be totally free from it. If ingested into the system this organism is capable of causing food poisoning and subsequent illness. 16 samples (4.4%) were found to be contaminated with salmonella. A few rare serotypes like *S. alachua, S. oranienburg, S. ohio* and *S. eastbourne* were isolated from fish samples.

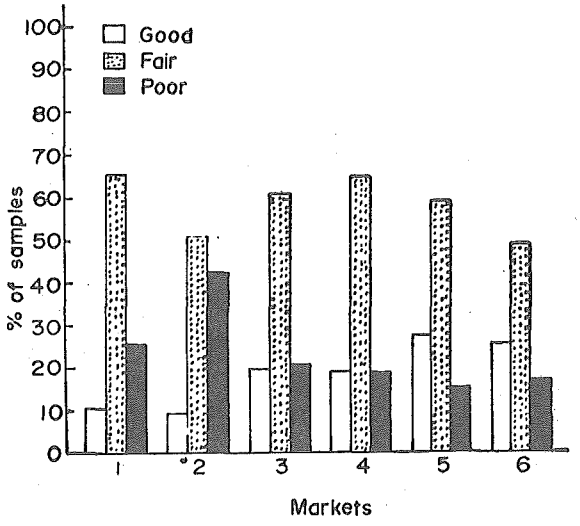

Fig. 3. Organoleptic evaluation.

e) Clostridium perfringens: *Clostridium perfringens* produce exotoxin which causes food poisoning and its presence in food items is undesirable. 14 samples (3.8%) were found to be contaminated with *Clostridium perfringens.*

Out of the total 360 samples examined 27 samples (7.5%) were found to be contaminated either with *Salmonella* or *Clostridium perfringens.* Presence of these pathogens in fish is a potential health hazard to the consumers. Eventhough the fish may look wholesome and fresh the presence of these organisms in them can lead to serious health problems. In order to avoid this danger fish in retail trade should be continuously monitored for the presence of pathogens.

Quality of fish in different markets

The sanitary and hygienic conditions in the markets have a direct bearing on the quality of fish being retailed. The quality characteristics of fish from different markets are presented in Fig. 3 and Table 2. It can be observed that there is a wide variation in the quality of fish among different markets. Based on organoleptic score, market 2 had the maximum percentage of poor quality samples followed by market 1. In the rest of the markets the quality variation was not much significant (Fig. 3). The results based on total volatile nitrogen values and total bacterial counts also exhibited a similar pattern (Figs. 3a and 3b). Considering the above three parameters together more than 30% of the samples in markets 3, 5 and 6 were found to be of good quality whereas, the corresponding figures for markets 4, 1 and 2 were 21.67%, 13.33% and 10.0%, respectively. Maximum number of poor quality samples were found in market 2 (46.67%) followed by market 1 (26.11%). In the other markets about 17%

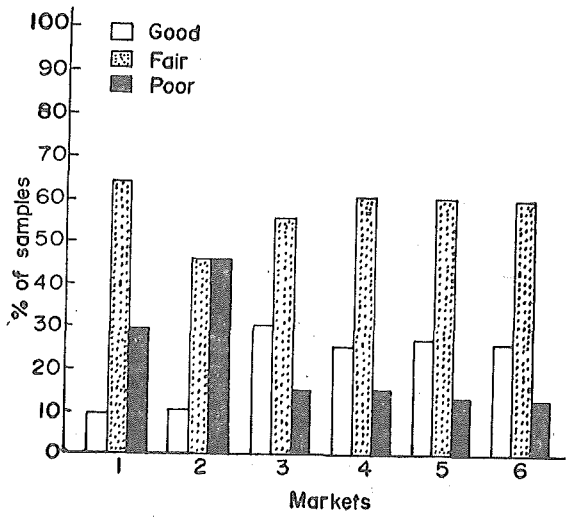

Fig. 3a. Total volatile nitrogen

Table 2. *Quality characteristics of fresh fish in different retail markets**

Sl. No. of markets	*E. coli* counts g^{-1}		Faecal streptococci counts g^{-1}		Coagulase positive staphylococci counts g^{-1}		Salmonella		*Clositridium perfrigens*	
	<20	>20	<1000	>1000	<100	>100	Absent	Present	Absent	Present
1	71.7	28.3	51.7	48.3	95.0	5.0	95.0	5.0	96.7	3.3
2	66.7	33.3	41.7	58.3	95.0	5.0	98.3	1.7	93.3	6.7
3	71.7	28.3	60.0	40.0	96.7	3.3	90.0	10.0	95.0	5.0
4	85.0	15.0	60.0	40.0	100.0	0.0	98.3	1.7	96.7	3.3
5	68.3	31.7	73.3	26.7	95.0	5.0	93.3	6.7	98.3	1.7
6	81.7	18.3	76.7	23.3	98.3	1.7	98.3	1.7	96.7	3.3

* The values given in the table represent percentage of the samples analysed

of the samples were found to be of poor quality. Samples of fair quality were maximum in market 1 (60.56%) and minimum in market 2 (43.33%), (Fig. 3c). *E. coli* contamination was found to be highest in market 2, with 33.3% of the samples having counts more than 20 g^{-1} and the least in market 4, with a corresponding value of 15%. Faecal streptococci contamination with counts higher than 1000 g^{-1} was the highest in market 2 and the least in market 6. Coagulase-positive staphylococci, *Salmonella* and *Clostridium perfringens* were detected in very few samples in all the markets. In three markets, 5% of the samples showed coagulase-positive staphylococci counts higher than 100 g^{-1}, whereas in one market none of the samples was above this limit. 10% of the samples in market 3 were found to be contaminated with *Salmonella* followed by 6.7% in market 5 and 6% in market 1. In the remaining three markets, *Salmonella* was detected in only one sample (1.7%) each. Contamination with *Clostridium perfringens* was the maximum in market 2 (6.7%) and minimum in market 5 (1.7%).

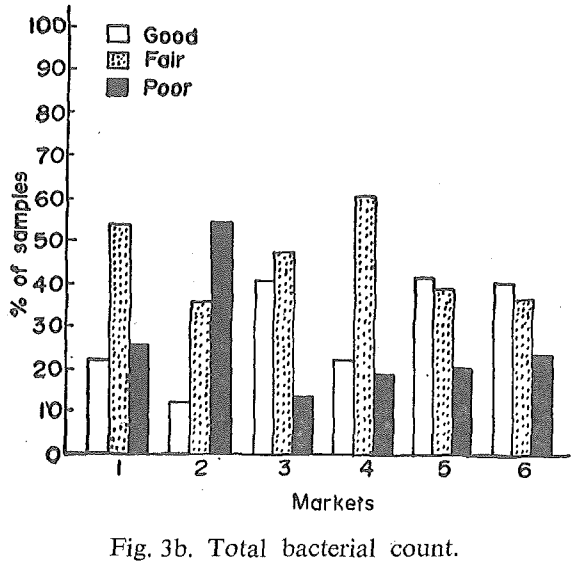

Fig. 3b. Total bacterial count.

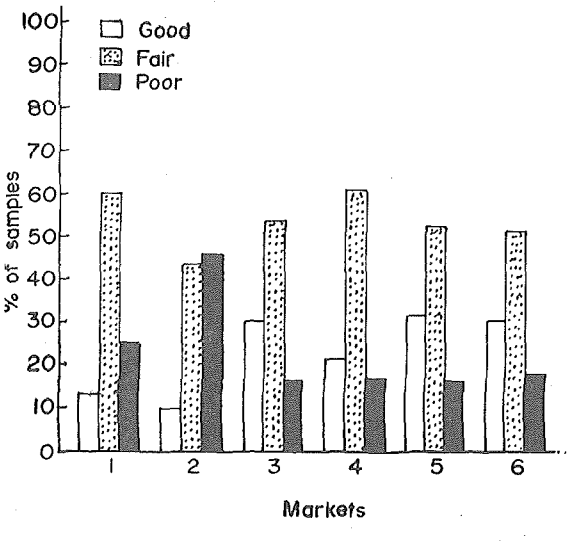

Fig. 3c. Organoleptic TVN and TBC values together

The Indian Standard Institution has stipulated certain basic requirements for fish markets (IS: 8082, 1976). None of the markets included in this study did conform to the set standards. However, based on the quality of fish available in the markets they can be classified into three categories. Markets 3, 4, 5 and 6 could be considered as good, market 1 as fair and market 2 as poor. Eventhough market 2 has better facilities in comparison with market 1, the

quality of fish in market 2 was consistantly poor. Market 2 is a part of a wholesale market for fresh fish whereas other markets are meant exclusively for retail trade. Being a wholesale market, fish at different stages of spoilage from distant places arrive in market 2. The material which is left unsold in the wholesale section due to inferior quality is invariably sold in the retail section. This explains the consistantly poor quality of fish in market 2. It was observed that sanitary and hygienic conditions and other general facilities in market 1 were inadequate compared to other markets which is reflected in the fish quality.

Samples of good, fair and poor quality were present in almost all fish species irrespective of their popularity, eventhough some special care is given for popular table fishes during handling. This study has revealed that the ultimate quality of fish is decided by the sanitary and hygienic conditions prevalent in the markets. Eventhough set standards on the basic requirements for fish markets are available, these are not strictly implemented. Immediate steps should be taken to implement the same and to train persons engaged in fish trade on good sanitary and hygienic practices in fish handling. It is high time that proper attention and serious thoughts are given to formulate quality standards for all the commonly available fish species sold in the domestic markets to protect the health of unwary consumers.

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References

AOAC (1975) *Official Methods of Analysis* (Horwitz, W., Ed.) 12th edn. Association of Official Analytical Chemists, Washington

Conway, E. J. (1947) in *Microdiffusion Analysis,* Revised Edn., d. Van-Nostrand Co. Inc. New York

IS:2237 (1971) *Specification for Frozen Prawns* (shrimp), First Revision. Indian Standards Institution, New Delhi

IS: 4780 (1978) *Specification for Pomfret-Fresh,* First Revision, Indian Standards Institution, New Delhi

IS: 4781 (1978) *Specification for Threadfin-Fresh,* First Revision, Indian Standards Institution, New Delhi

IS: 8082 (1976) *Specification for Basic Requirements for a Fish Market,* Indian Standards Instution, New Delhi

Iyer, T.S.G. & Chaudhuri, D. R. (1966) *Fish. Technol.* 3, 113

Iyer, T.S.G., Chaudhuri, D. R. & Pillai, V. K. (1966) *Fish. Technol.* 3, 44

Khot, J. B., Sherikar, A. T., Nadgauda, A. M. & Ajinkya, S. M. (1982) *Proc. Symp. Harvest and Post-harvest Technology of Fish* SOFT (I), Cochin

Mathen, C., Francis Thomas, Mathew, A. & Joseph, A. C. (1975) *Fish. Technol.* 12, 16

Nambiar, V. N. & Iyer, K. M. (1973) *Fish. Technol.* 10, 6

Pillai, V. K., Lekshmy, A., Govindan, T. K., *Mathen, C. &* Iyer, H. K. (1965) *Fish. Technol.* 2, 115

Pillai, V. K. & Rao, K. Krishna (1969) *FAO Technical Conference on Fish Inspection and Quality Control,* Halifax

Sreenivasan, R. & Joseph, K. C. (1966) *Fish. Technol.* 3, 103

Valsan, A. P., Nambiar, V. N., Damle, S. P., Garg, D. K., Iyer, T. S. G. & Vasu, N. M. (1982) *Proc. Symp.* Harvest and Post-harvest Technology of Fish, SOFT (I), Cochin